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EDITORIAL

Grow More Food. India though predominantly an agricultural country has been dependent to a considerable extent on foreign sources for her food supply. Before the war, besides large quantities of wheat from abroad, she was importing $1\frac{1}{2}$ to $2\frac{1}{2}$ million tons of rice from Burma, and of this quantity the share of Madras was 7,78,000 tons of rice. Recent developments having cut us off from this source of supply, it is imperative, that the drive for greater food production initiated by Government meets with an enthusiastic response from the cultivators. In times of war a sufficiency of food to meet the needs of the civil population and the army is of vital importance and neglect of this aspect will lead to disaster. Questions of prices and profits are of secondary importance.

It is gratifying to note in this connection, that Madras has within the last two years increased her rice production by nearly four lakhs of tons and is well on the way to increase it by another five lakhs tons, so that in a short time, she will be more or less self-sufficient with regard to this commodity. But much yet remains to be done, for not only should we grow sufficient food for ourselves, but we should have an adequate surplus also in order to meet the needs of the army, to supply the deficit in other provinces and to provide a reserve against a rainy day.

The programme of the Madras Government towards the increase of food production consists of giving encouragement to cultivators to bring more land under the plough; doing intensive propaganda among the cultivators to substitute food crops in place of commercial crops, such as, short staple cotton and tobacco, which have lost their external market at present, taking steps to increase the outturn of crops in the cultivated areas of the province by providing extended facilities to the *ryots* for obtaining a sufficient supply of good seed of improved strains of paddy and millets and also the requisite manure, and restricting the free export of rice and other food stuffs from the province. Though the possibility of extending the area under cultivation is very limited in its scope considerable success can be attained by concentrating our attention on the other parts of the programme. The absence of an external market for short staple cotton, groundnut and

tobacco, has to some extent forced the cultivators to adjust their cropping programme to suit the changing conditions but in certain localities, as for example, in the Ceded Districts, there is considerable difficulty in finding a substitute to grow in place of the *mungari* cotton owing to seasonal conditions. It is necessary to find ways and means to overcome such difficulties. The Agricultural Department has an important part to play in this programme and we appeal to the readers of the Madras Agricultural Journal, cultivators and members of the Department alike to consider food production as an integral part of our war efforts and strive their utmost to augment the resources of our country in this direction to ensure that victory to the Allied cause which is so necessary for the peace and well-being of mankind.

Birthday Honours. We are highly gratified to note that the honour of Knight Commander of the Indian Empire has been conferred on H. M. Hood Esq., I. C. S., Adviser to H. E. the Governor of Madras and head of the Development Department. We offer him our congratulations.

Grass Flora of the Travancore State with special reference to fodder grasses

By K. CHERIAN JACOB, L. Ag., F. L. S.,

Assistant, Botany Section, Agricultural Research Institute, Coimbatore, and Member, Provincial Standing Fodder and Grazing Committee

Introduction A grass survey of the Travancore State was made by the author between 16th November and 6th December 1941. Though Travancore State is just equal in area to a large district of the Madras Province, the ecological features exhibited are very diverse, ranging from subtemperate to tropical. The elevation varies from sea level to about 9,000 feet in height at Anamudi which is the highest point in South India. The State forms a narrow strip of country between the sea and the ghats. It has a long coast line on the western side and rises gradually to the Western Ghats which form the eastern boundary. The climate in most parts is humid due to the long coast line, presence of backwaters, lagoons, innumerable canals and rivers and also to the heavy rainfall received in the major portion of the State. The high ranges of the State have a semi-temperate climate. One half of the country is covered with mountains and many rivers take their origin from them and fall into the Arabian Sea on the western side. The soil in most parts of the State is reddish being of laterite formation. Due to the undulating nature of the country the land is subjected to both sheet and gully erosion. The fine particles of the soil are carried away by the rain water to the rivers and deposited in the backwaters and the sea. The land is, therefore, comparatively poor and the soil is deficient in mineral contents The substratum consists of gneiss while that of the adjoining British Indian districts except Malabar consists of limestone commonly known as *kankar*. The soil is, therefore, further deficient in calcium.

Rainfall The rainfall ranges from 33·6 inches at the Fruit Farm which is only two miles to the north of Cape Comorin, the southernmost point of the State, to 127 inches at Alwaye, the northernmost town in the State. Thus it increases gradually from South to North as seen from the table given below. It goes up even to 380 inches in the high ranges of the State (Peermade, Devicolam, etc.)

Rainfall data of different parts of the State

(Average for 50 years)

	From Cape Comorin	*Rainfall in inches.*
Fruit Farm	2 miles	33·6
Nagercoil	12 ,,	40
Trivandrum	54 ,,	67
Quilon	94 ,,	92
Kottarakara	100 ,,	105

Punalur	110 miles	118	Sub-mountainous tract.
Tiruvalla	134 ,,	111	
Kottayam	150 ,,	121	
Muvattupuzha	185 ,,	132	Do,
Alwaye	207 ,,	127	
Peermade (Twyford)		266	High Ranges
Munnar (Pettimudi)		380	,, ,,

Grass Flora of low rainfall area The southernmost part of the State for about 40 miles to the North of Cape Comorin receives rainfall below 40 inches and the flora of this part of the State is comparable to the adjoining British Districts like Tinnevelly, Madura, Coimbatore, etc. The grass flora of this tract is similar to those of the above mentioned districts with *Iseilema laxum* Hack, *Dactyloctenium aegyptium* Beauv., *Cynodon Dactylon* Pers., *Cynodon Barberi* Rang. and Tad., *Paspalidium flavidum* A. Camus., *Sporobolus diander* Beauv., *Sporobolus tremulus* Kunth., *Apluda aristata* Linn., *Aristida setacea* Retz. *Aristida depressa* Retz., *Tragus biflorus* Schult., *Chrysopogon montanus* Trin., *Amphilophis pertusa* Stapf, *Perotis indica* O. Ktz., *Digitaria marginata* Link., var. *fimbriata* Stapf, *Heteropogon contortus* Beauv., *Brachiaria distachya* Stapf, *Andropogon pumilus* Roxb., *Eremopogon foveolatus* Stapf, *Panicum trypheron* Schult., *Trachys muricata* Steud, *Panicum repens* Linn., *Enneapogon elegans* Stapf, *Oropetium Thomaeum* Trin., *Sehima nervosum* Stapf, *Cymbopogon coloratus* Stapf, *Digitaria longiflora* Pers., *Eragrostis unioloides* Nees., *Saccharum spontaneum* Linn., etc., predominating. A good proportion of these species, especially some of the best fodder grasses, viz., *Sehima nervosum* Stapf, *Iseilema laxum* Hack, *Trachys muricata* Steud., *Eremopogon foveolatus* Stapf., *Andropogon pumilus* Roxb., etc., disappear as one proceeds to the north of the State where the rainfall is progressively on the increase. It is the same case with the leguminous forage plants like *Alysicarpus vaginalis* DC., *Alysicarpus monilifer* DC., *Zornia diphylla* Pers., etc.

Grass Flora of high rainfall area The grass flora from Quilon to the northern boundary of the State is typical of the moist evergreen type. The fine grasses are replaced by those having coarse growth. They tend to grow tall producing more woody tissues. These characteristics do not go with good quality fodder species; consequently the cattle suffer. This seems to be one of the reasons for the cattle being poor in this State. Another reason is the lime deficiency in the soil. Consequent on this lime deficiency of soil even the grass flora found here is deficient in this very valuable mineral which is essential for the development of bones in animals. A third reason is the heavy rainfall received during one half of the year necessitating the cattle being kept indoors. Cattle generally are averse to graze grass when it is wet or when water particles are deposited on it. The chief grass species of this part of the State with high rainfall are *Ischaemum aristatum* Linn., *Ischaemum Rangacharianum* C. E. C. Fischer, *Chrysopogon orientalis* A. Camus., *Chrysopogon verticillatus* Trin.,

Themeda cymbaria Hack., *Themeda tremula* Hack., *Apluda aristata* Linn., *Cymbopogon flexuosus* Wats., *Arundinella leptochloa* Hk. f., *Arundinella mesophylla* Nees., *Arundinella holcoides* Trin, *Garnotia stricta* Brogn., *Eragrostis unioloides* Nees., *Heteropogon contortus* Beauv, *Chrysopogon aciculatus* Trin., *Themeda triandra* Forsk., *Alloteropsis cimicina* Stapf, *Vetiveria zizanioides* Nash, *Imperata cylindrica* Beauv., var. *Koenigii* Dur. et Sch., etc.

The grasses of the State may be broadly divided into pasture, hill, aquatic and introduced grasses, and also grass weeds in standing crops.

Pasture grasses The grasses of the pastures in the high rainfall areas are *Ischaemum aristatum* Linn., *Ischaemum Rangacharianum* C. E. C. Fischer, *Chrysopogon aciculatus* Trin., *Pseudanthistria umbellata* Hk. f., *Cynodon Dactylon* Pers., *Cyrtococcum patens* A. Camus (under partial shade), *Eragrostis unioloides* Nees, *Eragrostis plumosa* Link, *Digitaria marginata* Link, *Heteropogon contortus* Beauv., *Digitaria longiflora* Pers, *Sporobolus diander* Beauv., *Perotis indica* O. Ktz., etc. The cattle depend for grazing mainly on these grasses. The pasture grasses of the sandy soils are *Eragrostis plumosa* Link, *Perotis indica* O. Ktz., *Digitaria longiflora* Pers., *Digitaria marginata* Link, var. *fimbriata* Stapf, *Cynodon Dactylon* Pers., *Dactyloctenium aegyptium* Beauv., *Sporobolus diander* Beauv. (in shade), etc.

Hill grasses The hill grasses in the high rainfall areas are generally tall and their stems are often woody. Some of them attain a height of 10—12 feet. The common ones are *Themeda triandra* Forsk., *Themeda tremula* Hack, *Themeda cymbaria* Hack., *Apluda aristata* Linn., *Cymbopogon flexuosus* Wats., *Cymbopogon coloratus* Stapf, *Heteropogon contortus* Beauv., *Cymbopogon verticillatus* Trin., *Cymbopogon orientalis* A. Camus, *Eulalia tristachya* O. Ktz, *Imperata cylindrica* Beauv., var. *Koenigii* Dur. et Sch, *Ottochloa nodosa* Dandy, *Arundinella leptochloa* Hk., f., *Arundinella mesophylla* Nees., *Aristida setacea* Retz., *Garnotia stricta* Brogn., etc. Most of these are not readily grazed by cattle except the new growth that appears after forest fires or at the beginning of monsoons.

Aquatic grasses The main aquatic or semi-aquatic grasses are *Hygrorhiza aristata* Nees, *Saccolepis interrupta* Stapf, *Saccharum spontaneum* Linn, *Brachiaria mutica* Stapf, *Paspalidium punctatum* A. Cam, *Isachne dispar* Trin, *Oryza sativa* Linn. (wild form), *Phragmites Karka* Trin. etc. Most of them are good fodder grasses.

Grass weeds Grass weeds in standing crops are often the grasses that are found in pastures The main grasses of this category at Neyyatinkara in the low rainfall area are *Panicum trypheron* Schult., *Dactyloctenium aegyptium* Beauv., *Digitaria marginata* Link., var. *fimbriata* Stapf. *Amphilophis pertusa* Stapf, *Brachiaria ramosa* Stapf, *Urochloa reptans* Stapf, *Alloteropsis cimicina* Stapf, *Oplismenus compositus* Beauv., *Digitaria longiflora* Pers., *Cyrtococcum trigonum* A. Camus., *Panicum repens* Linn.,

etc. The following grasses occur mainly in the high rainfall areas from Quilon to the north:— *Ischaemum Rangacharianum* C. E. C. Fischer, *Ischaemum artistatum* Linn, *Alloteropsis cimicina* Stapf, *Brachiaria distachya* Stapf, *Chrysopogon aciculatus* Trin., *Digitaria marginata* Link., var. *fimbriata* Stapf, *Digitaria longiflora* Pers., *Arundinella leptochloa* Hk. f., *Panicum trypheron* Schult., *Dactyloctenium aegyptium* Beauv., *Perotis indica* O. Ktz., etc. These are often pulled out or cut and fed to cattle. These are also available for sale in towns.

Introduced grasses The following are the common introduced grasses used as fodder for cattle :--Guinea grass (*Panicum maximum* Jacq.), Napier (*Pennisetum purpureum* Schum.), Dry or thin Napier (*Pennisetum purpureum* Schum., var.), Mauritius grass (*Brachiaria mutica* Stapf) locally known as Colombu pullu and Natal grass *Rhynchelytrun roseum* Stapf).

Guinea grass (*Panicum maximum* Jacq.) is grown largely in the Government Grass Farm at Chuliamalai near Nedumangad and by leading planters like Messrs. Kurian John of Kottayam and M. K. Raghavan Pillai of Quilon, as an interplanted crop in coconut topes at Aymanam near Kottayam and Tirucoilvattam near Quilon respectively. It is also grown to a limited extent by *ryots* at Chirairambu near Tiruvalla and other places. It is grown as a rainfed crop and 5 – 8 cuttings are generally taken.

Napier grass (*Pennisetum purpureum* Schum.) is also grown in coconut topes at Aymanam. It gives about six cuttings a year.

Dry Napier (*Pennisetum purpureum* Schum.) is grown at Kottayam by Mr. Kurian John in comparatively poor soils and is thriving well. These fodder grasses are manured with compost.

Mauritius, Colombo, Water or Buffalo grass (*Brachiaria mutica* Stapf) is cultivated at Quilon as a perennial crop in about 15 acres in rice lands for the past 40 years. For the initial planting the stems are laid flat and bulky organic manures, such as house sweepings, municipal refuse, cattle dung, etc., are spread on them. New shoots appear from all nodes. About eight cuttings are taken during the year, five being during the six rainy months. The area is manured four to six times a year especially during summer months. Two coolies manage an acre of plantation, i. e., draining off excess water, application of manure, eradication of weeds, harvest, etc. It stands water logging to a considerable extent and flowers during summer. It is harvested before flowering. About 5,000 lb. (2,000 bundles of $2\frac{1}{2}$ lb. each in weight) of green fodder is the outturn per harvest per acre. The cost of 10 lb. of this fodder is about an anna. The fodder from these 15 acres meets the main fodder requirement of the town. It is relished better than any other grass.

Forage plants. Forage plants other than grasses that are met with in pastures are *Alysicarpus monilifer* DC., *Alysicarpus vaginalis* DC., *Zornia diphylla* Pers., *Desmodium triflorum* DC., (Cherupulladi), *Merremia tridentata* Hallier f. (Thirupan pullu), *Evolvulus alsinoides* Linn., (*Krishna*

kranthi or *Vishnu kranthi*, *Sebastiana Chamaelea* Muell Arg, etc. The first four are leguminous plants.

Forage trees The forage trees, i. e., the leaves of trees that are grazed by cattle and browsed by goats are *Pterocarpus Marsupium* Roxb. (Vengai), *Artocarpus integrifolia* Linn. (Pila), *Vitex altissima* Linn. f, *Ficus bengalensis* Linn. (goats alone browse), *Erythrina indica* Lam. (goats alone browse), etc. The leaves of the first two are available for sale in bazaars.

Rice crop as fodder At Kottarakara the tops of rice plants wherever there is rank growth are cut to a foot from the ground and fed to cattle. This prevents lodging of the plants when in ears. At Tirucoilvattam near Quilon a variety of rice locally known as Cheraadi or Chepadan which has a duration of a year is grown. Seeds are sown in March and harvested in the succeeding February. During the rainy months (June to October) three or four cuttings are taken and used as fodder. It is a double purpose rice variety and deserves trial in other localities. In these parts horsegram bhoosa (straw) is stacked in alternate layers with paddy straw and fed to cattle as a leguminous mixture.

Economic products of some grasses The following grasses that are not used as fodder are sources of some economic products:

1. *Cymbopogon flexuosus* Wats. Mal: *Vaattu pullu, Theruva* at Kothamangalam; *Gnaruganam* at Perumpazhuthur near Neyyattinkara. It grows wild in the State but is largely cultivated for the essential oil it contains. This oil is commercially known as "Cochin Lemon Grass Oil". The stems with leaves before flowering are cut and distilled and is now a war-time industry in this State. It also yields a fibrous root which is used in the manufacture of the weavers' brushes known as *kuchu* in Malayalam and *pulveri* in Tamil.

2. *Aristida setacea* Retz. Mal: *Oopan pullu, Koonthalam pullu, Moochvittan pullu.* It is the common *thodappan pullu* of the Tamil country. The strong fibrous roots of this grass which are about a cubit in length are also used for making the weavers' brushes referred to above. It is not cultivated but the plants that are growing wild in light soils at Perumpazhuthur near Neyyattinkara, Kottarakara and other places, are lifted in November towards the end of the North East monsoon. The roots are collected, dried in the sun for a day and rubbed with the hand against the mud floor of houses until the bark and dirt are removed. These are then taken to weaving centres, such as, Colachel, Thazhava and Kallukada in Karunagapalli Taluq, and sold to merchants at about two annas per pound. This industry is common among the poor classes of these places.

3. *Vetiveria zizanioides* Nash. Mal: *Ramacham.* It is cultivated at Perumpazhuthur near Neyyattinkara and other places. It thrives in red gravelly soil. It is lifted generally in the month of "Karkatakam" (August—September). Roots are cut and dried in the sun for a week and then taken to bazaar and sold at about two and a half annas per pound. It is the well

known Khus Khus of commerce and it is used for making chick thatties, mats, fans, etc.

4. *Saccharum spontaneum* Linn. Mal: *Pongal pullu.* Tam: *Viswamitra darbhai.* The horns of bulls and cows during *Pongal* are decorated with the arrows of this grass; hence the local name *pongal pullu.* At Nagercoil and other places the fine spikelets of the arrows are collected for filling pillows. It is said that these pillows have medicinal effect if used by patients suffering from eye diseases. Fresh leaves are cut to a cubit in length and dried by Brahmin *purohits* (priests) to be used in religious ceremonies.

5. *Themeda cymbaria* Hack. Mal: *Ezhum pullu, Nan pullu* at Peermade. The new growth that appears after forest fires at the commencement of the monsoon is sometimes grazed by cattle. It is the common thatch grass of this State.

6. *Imperata cylindrica* Beauv., var. *Koenigii* Dur. et Sch. Mal: *Potha;* Tam: *Darbhai pul.* Fresh leaves are cut to a cubit in length and dried by Brahmin *purohits* to be used in religious ceremonies. New growths that appear after forest fires are readily grazed by cattle.

7. *Bambusa arundinacea* Willd. Mal: *Mula, Illi.* The culms (stems) are used for building, scaffolding, floating heavy timber, punt-pole, etc. The split culms are woven into mats, baskets, fans, etc. The grain when available is eaten by the poor and also used medicinally. The leaves are eaten by cattle.

8. *Ochlandra travancorica* Gamble. Mal: *Eetta, Kaar eetta;* Tam: *Odai, Eeral.* The culms (stems) are used for mat and basket making. A coarse paper is also made from it. The leaves are much eaten by elephants.

The Fodder Problem in Travancore Some suggestions towards the solving of the fodder problem in this State.

1. Guinea grass and Napier grass including the thin or dry Napier may be grown in the high rainfall areas as interplanted crop in coconut topes *(Parambu).*

2. Colombo grass *(Brachiaria mutica* Stapf) may be grown in rice lands in the vicinity of towns where there is a demand for fodder.

3. *Sehima nervosum* Stapf may be encouraged to grow in the low rainfall areas in the hill ranges in the grazing areas near Nagercoil by rotational grazing and by providing partial shade by planting some leguminous fodder trees such as *Pterocarpus Marsupium* Roxb. and *Acacia alba* Willd. This grass thrives well under partial shade.

4. The famous Kolukkattai grass (*Cenchrus ciliaris* Linn.), the mainstay of the Kangayam Breed of cattle of Coimbatore District may be tried in the low rainfall areas.

Grasses are rich in protein before flowering and should be allowed to be grazed at this stage.

The low rainfall areas are suitable for cattle breeding.

A full list of grasses collected in the State during the tour is given below with the local names wherever available.

Short botanical descriptions, various local names, uses, etc., of most of the various species of grasses enumerated in this note are already published by the author in one or other of the publications given under reference.

1. *Imperata cylindrica* Beauv., var. *Koenigii* Dur. et Sch. Mal: *Potha* (Peermade), *Darbha* (Nilamel). It is very common in Peermade plateau, hence the plateau goes by the local name Potha medu.

2. *Saccharum spontaneum* Linn. Tam: *Pongalpul* (Velimala near Nagercoil).

3. *Dimeria Thwaitesii* Hack. Mal: *Kuthiravali, Kuthira pullu* (Chirairambu near Tiruvalla). A slender annual commonly found on the cuttings in low lying places. Stems are one to one and a half feet high and erect. Cattle graze this readily but the fodder yield is not much.

4. *Dimeria tenera* Trin. A tufted annual commonly found on the cuttings of hill slopes. Stems are 6—12 inches high, slender and erect. It is grazed by cattle but the fodder produced is very little.

5. *Eulalia tristachya* O. Ktz. Mal: *Thakati* (Nilamel). A perennial occurring commonly in hilly places. Stems are 2—4 feet high and erect with leaves of about a foot and a half in length. It is grazed by cattle before flowering.

6 *Ischaemum aristatum* Linn. Mal: *Chenkodi padoppan pullu* (Nedumangad), *Pandam kuththi, Koyyala padappan* (Kottarakara), *Nottodiyam pullu* (Varkala), *Kodiyara* (Chirairambu near Tiruvalla), *Kala kombu pullu* (Kozhencheri). It is a moderate fodder and is not considered a good one for milch cows.

7. *Ischaemum timorense* Kunth. Kan.: *Nilamunga hullu.* A widely creeping perennial grass found in hilly parts. Stems are wiry, deep red in colour and rooting at the nodes. Flowering stalks are about nine inches high. It is a good pasture grass.

8. *Ischaemum Rangacharianum* C. E. C. Fischer Mal: *Chenkodi pullu* (Nedumangad), *Kambi potaththan* (Nilamel), *Eerkkilodiyan, Thandan* (Kottarakara), *Odiyan pullu, Kattodiyam pullu, Moottan pullu* (Varkala), *Chovveli* (Aymanam), *Vrischika pullu* (Muvattupuzha), *Kala kombu pullu* (Kozhencheri). A widely creeping perennial grass commonly found in the pastures throughout the high rainfall areas. Stems are rooting at the nodes. Flowering branches are 1—1½ feet high. It is grazed by cattle but not considered a good fodder at Varkala and other places. The root hairs of the axillary roots that have not struck the ground gather moisture during the cold nights. The tips of these roots resemble ice drops which disappear with the rising of the sun.

9. *Sehima nervosum* Stapf Tam: *Paal pul* (Maruthvamalai near Nagercoil).

10. *Arthraxon Quartinianus* Nash. A slender pasture grass occurring at Peermade and other places. Stems are rooting at the nodes.

11. *Capillipedium Huegelii* Stapf It is a perennial. Stems are 2—3 feet long and rooting at the basal nodes. Cattle do not graze this readily due to the aromatic nature of the grass.

12. *Amphilophis pertusa* Stapf. Mal: *Vazha pul* (Neyyattinkara).

13. *Vetiveria zizanioides* Nash. Mal: *Ramachcham* (Neyyattinkara).

14. *Chrysopogon aciculatus* Trin. Mal: *Ooppan pullu* (Kottarakara), *Kombullu* (Kozhencheri); Tam: *Ona pullu* (Velimala near Nagercoil).

15. *Chrysopogon verticillatus* Trin. Mal: *Ennanchi pullu* (Nilamel). *Kal potha* (Peermade). A robust perennial occurring in mountainous tracts. Stems are 4—6 feet high and half an inch in diameter at the base, woody and erect. It is a very elegant grass when in flower and grazed by cattle before flowering.

16. *Chrysopogon orientalis* A. Camus A perennial occurring in hilly parts. Stems are as thick as crow's quill, 2—3 feet high ascending from a short creeping root-stock. It is not grazed by cattle after flowering.

17. *Chrysopogon montanus* Trin.

18. *Heteropogon contortus* Beauv. Mal: *Thakadi* (Kottarakara), *Irumbarappan pullu* (Varkala), *Ooppan pullu* (Quilon); Tam: *Chekkaattu pul* (Maruthvamalai near Nagercoil).

19. *Heteropogon oliganthus* Blatter A dwarf tufted annual found in mountainous places. Stems are 6—8 inches high and slender. It is not considered a fodder grass.

20. *Themeda triandra* Forsk.

21. *Themeda tremula* Hack. Mal: *Mlancholi pullu* (Peermade), *Podi pullu* (Peermade). A perennial found in hilly parts. Stems are one to four feet high ascending from a creeping root-stock. It is not grazed by cattle after flowering.

22. *Themeda cymbaria* Hack. Mal: *Malam pul, Ezhum pul* (Nilamel) *Nan pullu* (Peermade); Tam: *Tharuvai* (Velimalai near Nagercoil). A gregarious perennial grass covering extensive areas in mountainous tracts. It is the tallest grass in the State. Stems are 10—12 feet high. The new growth after forest fires is readily grazed by cattle but not touched by them after flowering. It is used as thatch grass.

23. *Iseilema laxum* Hack. Tam: *Kodi pullu* (Nagercoil).

24. *Pseudanthistiria umbellata* Hk. f. Mal: *Chenkodi pullu* (Nedumangad), *Blaavanchil* (Nilamel). It is a slender annual with straggling branches. Branches creep along the ground, rooting at the nodes. Flowering branches ascend and are about a foot high. It is a medium fodder.

25. *Apluda aristata* Linn. Mal: *Mulam pullu* (Neyyattinkara), *Otiyan pullu* (Nedumangad), *Kotta thalavan* (Mundakayam); Tam: *Kula nanal* (Velimala near Nagercoil). It attains a height of 6—8 feet in some parts of the State.

26. *Eremopogon foveolatus* Stapf

27. *Andropogon pumilus* Roxb.

28. *Cymbopogon flexuosus* Wats. Mal: *Vattu pullu* (Neyyattinkara, Kottarakara and Peermade), *Gnarukanam* (Neyyattinkara), *Chukkunari* (Peermade), *Theruva* (Kothamangalam).

29. *Cymbopogon coloratus* Stapf Tam: *Chukkunari pullu* (Maruthvamala near Nagercoil).

30. *Rottboellia exaltata* Linn. f.

31. *Mnesithea laevis* Kunth.

32. *Digitaria marginata* Link. Nature, habit and uses are the same as No. 33.

33. *Digitaria marginata* Link., var. *fimbriata* Stapf Mal: *Cheruthandan* (Chirairambu near Tiruvalla), *Kaala pullu* (Aymanam).

34. *Digitaria longiflora* Pers. Mal: *Padaththi pullu* (Nedumangad), *Ari pataththan* (Nilamel, Varkala), *Nei patappen* (Kottarakara), *Cherupatappan pullu* (Quilon), *Chengali pullu* (Chirairambu near Tiruvalla). This is considered the best pasture grass of the State.

35. *Alloteropsis cimicina* Stapf Mal: *Pooppan pullu* (Nedumangad), *Koda pullu* (Varkala), *Kola pullu* (Chirairambu near Tiruvalla).

36. *Eriochloa procera* C. E. Hubb.

37. *Brachiaria distachya* Stapf

38 *Brachiaria mutica* Stapf Mal: *Kulambu pullu* (Quilon). An introduced perennial which grows to four feet in height. For other details please see elsewhere

39. *Brachiaria ormosa* Stapf Mal: *Chama pothaval* (Neyyattinkara).

40. *Paspalum scrobiculatum* Linn An annual often cultivated for its grain. Stems are $1\frac{1}{2}$—$2\frac{1}{2}$ feet high, erect and rarely ascending. The spikelets develop hydrocyanic acid at the time of maturity of the seeds and at this stage it is poisonous to stock. It can be grazed by cattle before flowering without any deleterious effect.

41. *Stenotaphrum dimidiatum* Brogn. A perennial pasture grass occurring in rather moist situations. Stems are six to nine inches high, spreading on the ground and rooting at the nodes. It is a good pasture grass

42. *Paspalidium flavidum* A. Camus

43. *Paspalidium punctatum* A. Camus It is a perennial aquatic grass. Stems are two to four feet long, prostrating at the often floating base and rooting at the lower spongy nodes. It is a good fodder grass.

44. *Urochloa reptans* Stapf

45 *Echinochloa colona* Link.

46. *Oplismenus compositus* Beauv. Mal: *Patappan pullu* (Nedumangad), *Vaazhamparaththi* (Mookunni mala near Trivandrum).

47. *Oplismenus Burmannii* Beauv. Tam: *Moogil pullu*. It is a diffusely branched annual. Stems are 6—12 inches long and slender. It is a shade loving grass and is not grazed by cattle readily.

48. *Ottochloa nodosa* Dandy. It is a perennial grass. Stems are creeping and rooting at the nodes. Flowering branches ascend and are about nine inches high. It is grazed by cattle.

49. *Panicum humile* Nees. A cespitose annual found in dry places Stem is 12 - 15 inches high. It is grazed by cattle.

50. *Panicum trypheron* Schult. Mal: *Chama pullu* (Mookunni mala near Trivandrum and Nilamel), *Choma pathayam* (Chirairambu near Tiruvalla).

51. *Panicum maximum* Jacq. Guinea grass.

52. *Panicum repens* Linn. Mal: *Inji pullu* (Nilamel, Nedumangad); Tam: *Aana aruku* (Nagercoil).

53. *Panicum brevifolium* Linn. Mal: *Mulam pullu* (Kottarakara), It is a decumbent perennial grass. Stems are rooting at the basal nodes with flowering branches of about one foot high. It is grazed by cattle.

54. *Panicum montanum* Roxb. It is a perennial. Stems are not branched, 3—4 feet high and erect. It is grazed by cattle.

55. *Cyrtococcum trigonum* A Camus Mal: *Valari* (Nedumangad).

56. *Cyrtococcum radicans* Stapf Mal: *Othaval* (Mookunni mala near Trivandrum), *Kaattu pataththan pullu* (Varkala). A perennial thriving in shade. Stems are 1—2 feet long, slender, creeping and rooting at the nodes. Flowering branches are six to eight inches long. It is grazed by cattle.

57. *Saccolepis interrupta* Stapf Mal: *Kavado*; Tam: *Tondan pillu*; Kan: *Hodikai hullu*. A large perennial grass often floating in water. Stems are 3—6 feet long ascending from a creeping rootstock. Lower nodes produce fascicles of long stout roots clothed with root hairs. It is common in the *Kuttanad* rice area and is readily grazed by cattle.

58. *Saccolepis indica* Chase. Mal: *Muti pullu* (Kozhancheri), *Maththaambu pullu* (Aymanam). It is an annual thriving in moist situations. Stems are 6—18 inches high and erect. It is grazed by cattle.

59. *Setaria pallidefusca* Stapf et Hubb

60. *Rhynchelytrum roseum* Stapf et Hubb. Natal grass.

61. *Pennisetum purpureum* Schum. Napier grass.

62. *Isachne dispar* Trin. Mal: *Valari* (Nedumangad), *Vanchi pullu* (Kottarakara). It is a troublesome weed in rice lands at Nedumangad and other places.

63. *Arundinella avenacea* Munro. It is a weak annual straggling among other grasses. Stems are 12—15 inches long, slender and ascending. Cattle nibble this.

64. *Arundinella mesophylla* Nees. It is an annual occurring in mountainous tracts. Stems are 15—18 inches long and erect. It is grazed by cattle before flowering.

65. *Arundinella holcoides* Trin. Mal: *Molam pullu* (Peermade). is a very hairy annual. Stems are 12—18 inches high. It is a moderate fodder.

66. *Arundinella leptochloa* Hk. f. Mal: *Mulam pullu* (Nedumangad), *Ëththakka pullu* (Chirairambu near Tiruvalla). It is a perennial occurring in the high rainfall areas. Stems are as thick as a crow quill and 2—4 feet high with a woody root-stock. It is one of the commonest grasses and a moderate fodder.

67. *Phragmites Karka* Trin. Mal: *Karakam, Kolanjil.* It grows near water courses in large colonies. It is often planted on the sides of bunds and other situations which are subjected to strong currents or waves to prevent soil erosion. It is very common at Alleppey and other places in *Kuttanad.* Stems are erect and 10—15 feet high. These are made into pipes and split stems are plaited into mats.

68. *Aristida depressa* Retz.

69. *Aristida setacea* Retz. Mal: *Koonthalam pullu, Moochvittan pullu* (Neyyattinkara), *Ooppan pullu* (Kottarakara); Tam: *Poonchatta* (Maruthvamalai near Nagercoil), *Eakkil pullu* (Velimalai near Nagercoil).

70. *Garnotia stricta* Brogn. It is generally perennial but sometimes annual. It is a very variable grass occurring in mountainous tracts and often found growing on rock cuttings. It is not considered a fodder.

71. *Trachys muricata* Steud.

72. *Tragus biflorus* Schult. Tam: *Ottaththi* (Maruthvamalai).

73. *Perotis indica* O Ktz. Mal: *Ooppan pullu* (Varkala).

74. *Sporobolus diander* Beauv.

75. *Sporobolus tremulus* Kunth.

76. *Sporobolus orientalis* Kunth. It is a stoloniferous perennial growing usually in saline soils. Stems are 6—18 inches high with geniculately ascending branches. Leaf tips being spiny it is not grazed by cattle.

77. *Sporobolus piliferus* Kunth. It is a cespitose annual occurring in mountainous places. Stems are 3—12 inches high and erect. It is a moderate fodder.

78. *Eragrostis riparia* Nees.

79. *Eragrostis viscosa* Trin. It is a viscid annual occurring in rather low lying places. Stems are $1\frac{1}{2}$—2 feet high. It is grazed by cattle.

80. *Eragrostis plumosa* Link. Mal: *Naakkotti* (Mookunnimala), *Pooppan pullu* (Chirairambu near Tiruvalla).

81. *Eragrostis unioloides* Nees. Mal: *Vatti pullu* (Muvattupuzha), *Kaala moonchi pullu* (Aymanam).

82. *Eragrostis gangetica* Steud. It is a tufted perennial occurring in moist situations. Stems are 1 - 3 feet high. It is readily eaten by cattle.

83. *Eragrostis pilosa* Beauv.

84. *Oropetium Thomaeum* Trin.

85. *Cynodon Dactylon* Pers. Mal: *Karuka pullu* (Varkala); Tam: *Aruvan pullu* (Nagercoil).

86. *Cynodon Barberi* Rang. and Tad.

87. *Chloris barbata* Sw.

88. *Eleusine indica* Gaertn. Tam: *Thippa ragi.* It is a tufted annual occurring in low lying places. Stems are 1—2 feet high, slightly compressed and erect. It is readily grazed by cattle.

89. *Doctyloctenium aegyptium* Beauv. Mal: *Koovaragu* (Mookunnimala), *Koda pullu* (Koznencheri).

90. *Enneapogon elegans* Stapf It is a perennial. Stems are 3—18 inches high, wiry and erect. It is a moderate fodder.

91. *Oryza sativa* Linn. Mal: *Navara.* It is an aquatic annual occurring commonly in water courses in *Kuttanad* rice area. It is the wild form of the cultivated rice plant. Stems are 2—10 feet long and creeping or floating. It is grazed by cattle. The grain is used medicinally.

92. *Hygrorhiza aristata* Nees. Tam: *Valli pullu.* It is a perennial floating grass common in canals in *Kuttanad* rice land area. Stems are 1—2 feet long, spongy with feathery whorled roots at the nodes. It is readily eaten by cattle.

93. *Dendrocalamus strictus* Nees. Mal: *Kallan mula.* It is a spineless bamboo occurring only in the Anjinaad valley in the State, other places being too moist for its growth. A densely tufted bamboo with solid or nearly solid culms growing to a height of 15—50 feet and 1½ 3 inches across near the base. It flowers once in thirty years and dies down after fruiting. The culms (stems) are used for poles, lathies, mat and basket making. The leaves are eaten by cattle.

94. *Bambusa arundinacea* Willd. Mal: *Mula, Illi.* It is thorny and is the commonest bamboo in the State. It occurs in sub-mountainous and mountainous tracts. The culms are hollow and they attain a height of 60—:00 feet and 4—7 inches across at the base. It flowers once in 30 years and dies after fruiting. The culms are used for buildings, scaffolding, etc.

95. *Oxytenanthera monadelpha* Alston. (*O. Thwaitesii* Munro). Mal: *Watta.* It grows gregariously in the evergreen forests at high elevations. The plants are erect, spineless and reed-like. Culms (stems) are 10—12 feet high and one inch across and may be used for fencing and basket making.

96. *Ochlandra scriptoria* C. E. C. Fischer (*O. Rheedii* Benth.) Mal: *Ottal, Ammei, Kolanjil.* It occurs at low elevations growing in thick clumps on river banks. Culms (stems) are 15—20 feet high and one inch across at the base. It flowers sporadically every year and does not die down after fruiting. The culms (stems) are used for mat and basket making.

97. *Ochlandra scriptoria* C. E. C. Fischer., var. *sivagiriana* Gamble. Mal: *Ottal.* It resembles *O. scriptoria* C. E. C. Fischer in all respects except the leaves and spikelets being longer. It is found at Ponmudi in the Nedumangad Taluq.

98. *Ochlandra travancorica* Gamble Mal: *Eetta*; Tam: *Eeral, Odai.* It grows gregariously in evergreen forests throughout the State covering

large areas with dense growth. It flowers at long intervals and dies down after fruiting. Culms are 10—20 feet high and 1—2½ inches across at the base and are in great demand locally for mat and basket making. A coarse paper is also made from it. The leaves are much eaten by elephants.

99. *Ochlandra Wightii* C. E. C. Fischer (*O. Brandisii* Gamble). Mal: *Eetta*. It occurs at low elevations. It is found at Pallode, Kallar, etc., in the Nedumangad Taluq. It resembles *O. travancorica* Gamble and the culms are put to the same use as those of *O. travancorica* Gamble.

Five other species of grasses which are not represented in the Madras Herbarium at Coimbatore were also collected during the tour. They are under study and some of them may prove to be new species. One of these known at Peermade as *Thavala* pullu is a pasture grass thriving in moist situations. It is common on the roadsides at Kottarakara and other places.

My thanks are due to Sri T. R. Naganatha Ayyar for assisting me in this investigation.

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A Note on the Cultivation of Mango Ginger in the Neighbourhood of Anakapalli (Vizagapatam District).

By A. SANKARAM, B. Sc. (Ag.)

Introduction The pickles form an indispensable side-dish in our diet. They are considered to be appetisers and to help in digestion. Of the several kinds of pickles in common use, 'Mango ginger' is a special favourite with the *Andhras* in the Northern Circars. In the preparation of this pickle the addition of an adequate amount of lime juice, besides the required quantities of chillies and salt, is essential to give a pleasing taste.

Mango ginger (*Curcuma Amada* Roxb.) belongs to the family *Zingiberaceae*. Like the other members of the family, the plant is a perennial herb with an underground rhizome and large erect leafy aerial branches. The plant grows wild in Bengal and on the hills.

The cultivation of the crop is mainly concentrated in and around Anakapalli, though recently it is known to have been taken up by a few *ryots* in the villages round about Rajahmundry of the East Godavari District. The details of the cultivation of this crop as practised in the neighbourhood of Anakapalli are presented in this short note.

Soil and Preparatory Cultivation Soils of high fertility with free drainage, e. g. sandy loams, are generally preferred for this crop. In the garden lands the crop is grown in rotation with *ragi* or any vegetable crop like brinjal or *bendai*, etc. The crop is also raised in wet lands with

supplemental wells. After the removal of the previous crop the preparatory cultivation commences with the thorough ploughing of the land. As many as 10 to 15 ploughings are given to bring the land to a very fine tilth. The ploughed field is then formed into beds of 5 ft. × 5 ft. Irrigation channels are formed between every set of two beds. The crop responds fairly well to manuring. Sheep penning in the field is generally resorted to besides the application of about 15 cart loads of farmyard manure.

Seed material and planting The preparatory work which commences in March comes to a close by the end of April and planting will be in progress in May or June soon after some showers are received. The seed material for planting consists of the rhizomes taken from a previous crop and preserved with care. During the harvest in March good and healthy rhizomes are carefully selected to serve as planting material for the next year's crop. A pit dug in a cool place preferably under a thatched shed is filled with the selected rhizomes and fine sand, in alternate layers. It is then closed with a wooden plank and finally plastered over with mud. This pit is opened in May and the material taken out and spread to dry before it is ready for planting. During this process of preservation the material suffers a loss of 15 to 20 per cent by weight. This seed-ginger is cut into small bits of about an inch long having two or three sprouts.

The seed beds are first watered. Bits of seed ginger are distributed, usually by a woman cooly, one at each sowing spot $1\frac{1}{2}$ ft. apart in rows and at distances of $1\frac{1}{2}$ ft. between each row. A man follows her digging at the spot with a small crowbar to a depth of 6 in. where the rhizome is left and planting it. Soon after sowing, the entire field is shaded with a thick covering of leaves (*Anona squamosa* leaves that are commonly available are used here). About 200 to 250 lb. of the rhizomes are required to plant an acre of land.

Irrigation The crop requires copious watering but along with it drainage of any stagnant water in the field is very important to get satisfactory results. On the whole the crop requires ten irrigations besides the rainfall received during the life of the crop. The practice of well irrigation with a *picotah* is very common with the *ryots*.

After care The seed begins to germinate in about a week after planting, and in about a month it grows to a foot above the ground. The shade is completely removed by this time. At this stage the first hoeing is given and the second following it after a month. A third hoeing is given a week or two after the second, if necessary. Every care is taken to keep the field free of weeds.

Harvest The crop is a short duration one being ready for harvest in about 4 to 5 months from the date of planting. The maturity of the crop is indicated by the drying up of a number of bottom leaves and cessation of all vegetative growth. The harvest commences in October and is carried on in stages, extending the period of harvest till the end of January. The

harvest consists in lifting the entire plants by digging around them with a crowbar. The rhizomes are carefully collected in a basket. The fresh rhizomes are cleaned in clear water to remove the soil adhering to them. The roots of each rhizome are removed with a knife. The produce is then dried in the shade and made ready for the market. The harvest and preparation of the produce for the market requires heavy labour. About 35 women are required to get the produce of 40 cents of land to a marketable condition.

Yield and Marketing. A good crop gives about 12,000 lb. of marketable stuff and an average yield can be taken to be 9,000 lb. per acre. There is a good demand for the stuff in the local market. A fairly large percentage of the product is exported to Madras, Nellore, Tenali, Rajahmundry, Cocanada, Vizagapatam and Vizianagram, where it finds a quick sale. The produce is packed commonly in gunnies each bag containing 240 lb. and rarely in palmyra baskets. The prices are very varying from Rs. 0—8—0 to Rs. 2—0—0 per maund of 24 lb., the variation mainly depending upon the season and demand. Generally the price is at its maximum during October and March and at its minimum during December. The vegetable dealers of Anakapalli who form the middlemen for the export trade purchase the produce directly from the growers. On an average the primary producer gets a net gain of Rs. 0—6—0 per maund while the middleman gets a net profit of Rs. 0—4—0 per maund.

Economics of cultivation The cost of cultivation comes to Rs. 130 per acre. Calculating the average yield to be 9,000 lb. valued at Rs. 0-0-6 per lb. the gross income from an acre will be Rs. 280 and the net gain Rs. 150 per acre.

Cost of Cultivation per acre—Details.

Preparatory cultivation	Rs.	15—0—0
15 cart loads of farm yard manure and sheep penning		20—0—0
Planting material and planting		30—0—0
10 Irrigations		30—0—0
After care (2 hoeings)		5—0—0
Harvesting and cleaning		25—0—0
Assessment, etc.		5—0—0
Total cost of cultivation per acre		130—0—0
Yield 9,000 lb. valued at 0—0—6 per lb.		280—0—0
Net gain per acre		150—0—0

Conclusion The average holding of a *ryot* with respect to this particular crop ranges from 30 cents to 1½ acres. Only a few *ryots* grow it on an acre scale. In view of the decent profits obtained in this crop it should be an attractive proposition for vegetable gardeners in the neighbourhood of urban areas to take up its cultivation.

My grateful thanks are due to Sri. T. Nataraj, B.A., B. Sc. (Ag.), Assistant Lecturer in Agriculture, Agricultural College, Coimbatore, for the help rendered in the preparation of this note.

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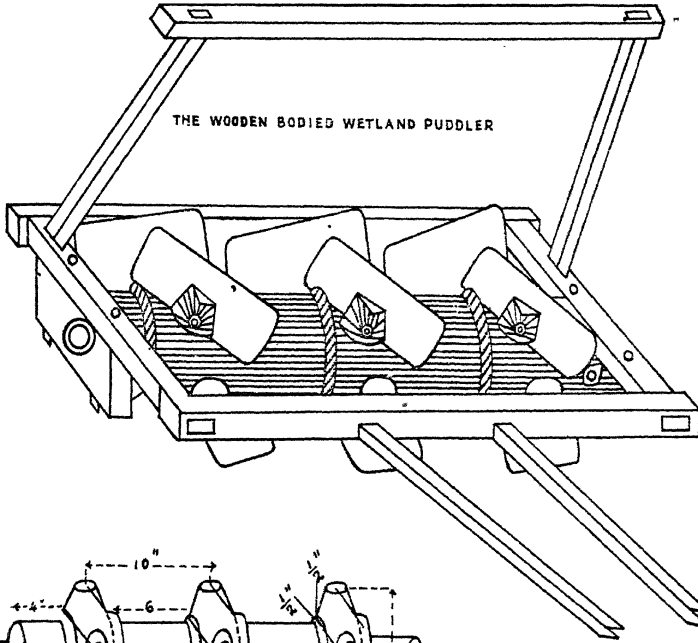
The Puddler

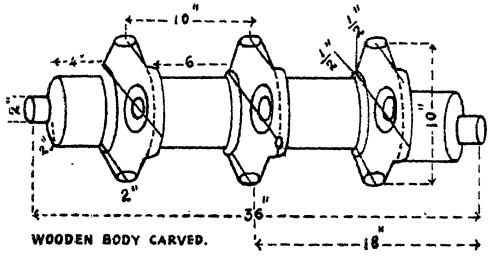
By M. SANJEEVA REDDY,

Landlord, President, Panchayat Board, Manempalli and Secretary, Taluq Agricultural Improvement Committee, Hindupur.

The "puddler" is an ingenious agricultural implement. It is used primarily for puddling and secondarily for trampling leaf manure in wetlands for paddy cultivation. It is, therefore, a dual purpose implement. Just as a tank is the main weapon on land to win a war so is this puddler—now nicknamed wetland tank – for the successful cultivation of paddy with the minimum labour on maximum area within a minimum time limit. It was introduced in the Hindupur Taluk of the Anantapur District for the first time in 1940 by the Agricultural Department when the price of each was Rs. 21. Its price now is Rs. 36 which is beyond the means of an ordinary cultivator. This original implement is of all iron parts consisting of galvanized iron pipe 3 feet long, 3 cast iron hubs of 4 spokes each to take in iron plates, flat iron handle and frame and a number of bolts and nuts that cannot be made or repaired by a village smith. Due to war the price of iron as everybody knows has gone up and a time has now come when the minimum quantity of iron will have to be used for such implements.

Its usefulness and familiarity on the one hand and the prohibitive cost on the other makes one neither give it up nor go in for it and leaves him in a dilemma. At such a time Sri K. V. Seshagiri Rao, the local Agricultural Demonstrator made a puddler of all wood except the plates which cannot be replaced by any other cheap material. This consists of a log of babul *Acacia arabica* (*thumma* in Telugu and *jali* in Kanarese) 3 feet long and 10 to 11 inches in diameter. For an implement which works in water and mire no other wood is better fitted. This log is so carved out even by an ordinary village carpenter to contain all parts in one, viz., axle at either end, the 3 hubs with 12 spokes – 3 on each side to take in iron plates 10 to 11×6 inches. To prevent the wood from being worn out the two ends of the axle are covered with iron plate rings. The whole body turns on these two axle ends in two babul wood bushes (the only wearing parts requiring replenishment for every 20 acres work at a very cheap cost) which are in turn fitted to a frame of babul wood by means of wooden pegs to which are fitted the babul wood handle and two shaft poles of any other available wood. The iron plates used were not new but were cut from old discarded jaggery pans thrown away long time ago in stack yards. In these days this wooden puddler has come as a boon to the *ryots* of quite ordinary means too. For a *ryot* who possesses, as he generally does, all these materials this implement costs him almost nothing and he can get it made by his own carpenter. If one has to get it made by purchase of all materials it costs about Rs. 15 as detailed below:





WOODEN BODY CARVED.

[K.V.S.RAO]

Babul wood for body-frame, handle, etc. Rs. 2—8—0. 2 shaft poles Rs. 1—8—0. Iron plates (at the present rate) Rs. 7—0—0. Making charges Rs. 3—8—0. Nails, rings, etc. Rs. 0—8—0. Total Rs. 15—0—0.

Being intimate with all-iron and all-wood puddlers, I am of opinion, that the latter being heavier works steadily, puddles well and tramples leaf branches to a good depth uniformly with ease.

The Puddler—a food production drive implement To prepare an acre of land in major portion of the Anantapur District and particularly in the southern taluks and the adjoining portions of the Mysore State six ploughings are to be given with a country plough (cross, across and diagonal) which require 18 pairs of animals at 3 pairs per time. In addition to this Rs. 2 are required for trampling leaf by human labour. This is a very slow method requiring about 20 days mainly due to want of sufficient number of animals either of his own or for hire. It is very tedious and the animals get worn out. In the main the results are that only a few acres of land could be cultivated, the season of planting is long delayed and the yield ultimately goes down. If a puddler is used only 7 pairs of animals are required to get ready an acre, six pairs to work the country plough twice and one pair of average size to work the puddler twice or thrice. Thus Rs. 2 and labour of 11 pairs are saved. When an iron plough like Cooper No. 11, Kirloskar No. 14 or P. S. G. No. 16B is used 3 pairs of animals are enough, two pairs to work the plough once and one pair to work the puddler twice or thrice, thus reducing the labour by 15 pairs and Rs. 2. Be there leaf trampling or not the puddler is highly essential for economic and quick cultivation of paddy on a large area with good results.

In these days of world war when exports and imports have been greatly affected the main problem to solve has been to find ways and means of increasing food production specially that of rice. The Taluk Agricultural Improvement Committee of Hindupur which was started in December 1940 at the instance of the local Agricultural Demonstrator with the main purpose of disseminating improved methods of agriculture on a mass scale as a means of food production drive got a dozen of such puddlers made locally and distributed them as prizes along with other labour saving and efficient implements like Bellary *gorrus, guntakas, danthulu,* iron ploughs in place of the usual prizes of cash, cups and medals with the object of demonstrating them in various places from where the knowledge may disseminate further.

Interested and enthusiastic as I am in such schemes of welfare of a country I earnestly pray that the concerned authorities and the public in general and the *ryots* in particular take to this simple and invaluable implement—the wooden bodied wetland puddler.

SELECTED ARTICLES

New Economic Crops.

New economic crops are required for India, because the areas under certain crops such as short staple cotton have to be reduced as the result of the loss of foreign markets, and also because certain products previously imported are no longer obtainable and it is necessary to make arrangements for their production in this country. By new crops one does not necessarily mean those which have not been introduced into India before and may consider also those crops which have already been tried on a small scale or have established themselves only in very limited areas and which may be worthy of further exploitation. India with a variety of climatic and soil conditions, offers great chances for the successful cultivation of exotic plants in different parts of the country.

Need for information There is a great deal of information regarding trials with such crops carried out in India, which has not been published but which is available with the persons who actually carried out the trials. As a preliminary, therefore, it is desirable that before a list of suitable new crops is actually drawn up arrangements should be made to collect available information from those who have personal experience of these less well known crops. This information when collected will form a basis for future planning and will be a useful supplement to Sir George Watt's well-known and exceedingly useful *Dictionary of the Economic Products of India*. Due attention would have to be paid to the trade demand and the markets for the raw as well as finished products. Only such crops should be recommended to the grower as are likely to find a ready market.

The figures relating to the economics of production and marketing as given in various reports in the past have become in most cases, out of date as a result of the conditions brought about by the war. While considering the economics of such crops, these figures, therefore, should not be very strictly adhered to.

There is a large number of plants which appear to have distinct commercial possibilities, but the present article is restricted to only a few selected ones.

Papaya as source of papain Papaya *(Carica papaya)* is a native of Central America and the West Indies. Commercially it is important as a source of papain a digestive enzyme resembling animal pepsin, and used as a remedy for dyspepsia. Papain is obtained from the juice of the fruits. At the present time the only country producing papain on a commercial scale is Ceylon, which in 1932 exported 45,575 lb. of papain to the United States of America, 16,022 lb. to the United Kingdom and 1,555 lb. to France. In Ceylon 100 to 175 lb. of dried material per acre is the average yield.

In India papaya cultivation has been successful in Madras, Bihar, Bengal, Bombay and the United Provinces, but no large-scale plantations have been tried for the manufacture of papain. A number of high yielding varieties have been selected for India; of these special mention may be made of Washington, Giant, Hawaii, Ceylon Long, Ranchi Mammoth and Calcutta.

Olive The olive (*Olea europaea*) is a native of Western Asia. *O. cuspidata* is the wild olive of Sind, North-Western Himalayas and Kashmir. The ripe fruit properly salted is one of the most sustaining foods known in Europe, where it takes the place of opium, but is without the evils of the drug. Olive oil is one of the finest known in commerce as a food and as a lubricant in wool spinning. The

true olive is a very hardy tree, is drought-resistant and thrives well in dry climates with mild winters. Loamy soils are most suitable for its cultivation.

The British Empire produces only negligible quantities of olive oil. Greece with 18·6 per cent. of its agricultural income derived from olive is one of the major olive oil producing countries. In India the olive has become established in parts of Northern India and bears fruit abundantly, but the fruits sometimes do not mature well and drop down in later stages. Experimental work in connection with olives in Northern India indicates that olive cultivation can be made popular at a comparatively low cost. That the climate and soil along the foothills of the Northern Punjab and the North West Frontier Province is suitable for the growth of the olive is evident from the abundant growth of the wild olive. Grafting and budding scions of the best European olive on the wild stock should yield fair crops and it is possible that by suitable hybridization a good sized fruit may be produced having the natural sweetness of the wild olive.

The plant comes in bearing after five or six years and yields 1½ cwt. of oil olives and 30 to 40 gallons of oil per ton. Some of the best Australian varieties such as Sevillano Macrocarpa, Verdale and Hardy's Mammoth may be tried.

As a part of rural uplift work in the United Provinces olive trees have been planted.

Tung oil The tung oil trees (*Aleurites Fordii*) is a native of China. The kernels yield a valuable drying oil used in paints, varnishes, etc. Between 1926 and 1928 China exported 54,440 tons of tung oil valued at £ 29,43,285 annually on the average. This indicates the magnitude of its economic importance in the commercial world.

In India *Aleurites Fordii* and *A. montana* were introduced about 30 years ago and the latter is doing better. *A. moraccana* is also suitable and gives satisfactory yields. The plant comes in full bearing in the tenth year. Fifty to sixty pounds of dry fruits per acre is the expected yield, the oil percentage being about 40.

In view of the growing commercial importance of these trees and of the possibilities of countries like India and Burma possessing soil and climatic conditions suited to their growth, the crop is considered worth raising in many of the warm temperate and subtropical parts.

Hops The importance of hops lies in the flowers which are used in breweries. According to American experience long and severe winters kill many plants and continued damp or foggy weather is usually followed by severe attacks of lice or mold. Rich alluvial lands or deep sandy or gravelly loams are preferred.

In India, Chamba and Kashmir States show promise of attaining success with hops. In the Himalayan tracts which escape the violence of the summer monsoons, there appears to be a good chance of hop cultivation. The demand for hops for brewing purposes should induce further efforts on the part of the planters. At present large supplies of hops are imported from outside.

Sisal Sisal (*Agave americana* and A. *Sisalana)* is a valuable fibre plant. On account of the ease with which the fibre takes the colour and its power to bear changes of humidity sisal-hemp has become important for the textile industry. The plant is also a source of paper material and alcohol is manufactured from its leaves. It flourishes under the most diverse circumstances and dry areas are specially suited to it. After the land has been once planted, very little expenditure is incurred.

Sisal plantations have not on the whole been very successful in India. Sometimes this has been due to the wrong localities being chosen for the different varieties. For example Java sisal which requires high rainfall has been

introduced to dry tracts. Again, African sisal which grows well under 40 to 60 in. rainfall has been introduced to very wet tracts. Sisal cultivation in India could be tried in combination with tea and coffee plantations.

Unfortunately, in recent years the prices of the fibre have been greatly reduced. Nevertheless, there is still a good margin of profit left.

Ramie. Ramie (*Boehmeria nivea*) is another fibre-yielding plant worthy of trial in India. The fibre being the finest and the strongest is put to several uses, viz., in the making of fishing nets, as fabric for wings of aeroplanes and for the manufacture of parachutes. China used to grow ramie on a commercial scale and export it to Japan. In India it is grown to a small extent in Bengal and Assam. Efforts to raise ramie as a field crop have not been successful in India. It grows best in a warm temperate climate where the winters are cool. Very fertile sandy loam alluvial soil having good drainage is the type of soil required for its successful cultivation.

Cassava. Cassava (*Manihot utilissima*) is a native of Tropical America. From the sliced roots manioc or cassava meal is prepared. The starch is used under the name of Brazilian arrowroot, and this when made into pellets on hot plates forms the tapioca of commerce. Cassarup a powerful antiseptic, is a by-product.

The plant is one of the most productive in the world and it has been claimed that an acre of cassava will yield more nutritive matter than six times the same area under wheat. It was introduced in Travancore about 60 years ago and, in the State, is next in importance to paddy. Cochin and Malabar also grow it. It will grow in almost any soil and needs very little care. It stands drought well but not frost. The green tops are excellent food for cattle.

Cassava from Java was introduced and multiplied in Mysore some years ago. It has been introduced to Orissa also.

Sago. Sago palm (*Metroxylon Sagu*) is a native of Malaya. Sago has the characters of starch, is nutritive, easily digestible and hence given during convalescence in acute diseases. The tree flourishes in low, marshy places.

England imports 4,000 tons of sago annually chiefly from Singapore and Sumatra.

Pistachio. Pistachio (*Pistacia vera*) Pista has its original home in Asia Minor. It is a small tree forming forest usually on sandstone formations, in Syria Mesopotamia and Khorasan. The fruit yields resin and oil, and is also used in confectionery. Most of the supplies of pistachio nuts are received in India from Persia, Palestine and other neighbouring countries.

From the recorded evidence of the existence of this tree in Rawalpindi Srinagar and Kashmir, there appears to be no reason why with a little trouble the cultivation of this valuable tree should not be carried on with success at least along the whole of the North Western frontier.

It has been observed that the seedling plants do not usually fruit. In this direction budding and grafting may help in overcoming this difficulty,

Stramonium. The drug stramonium is obtained from *Datura stramonium*. India is the only country where both *D. stramonium* and *D. Fastuosa* grow plentifully. In spite of all this, most of the stramonium preparations in the market are imported from outside.

Considering the importance of the drug and the ease with which the Datura plants could be grown it would be worth while having regular plantations in places which are otherwise not suitable for general cultivation.

Liquorice. This drug is the dried root of a leguminous plant, *Glycyrrhiza glabra*, found in the sub-Himalayan tract in the Punjab. The commercial supplies,

however, come from Asia Minor, Turkestan and the area surrounding the Persian Gulf. It is also cultivated in China, France, Italy and Germany. The preparations of liquorice are very popular both in the Western and Indian systems of medicine. It is used in the preparation of various cough lozenges and also for sweetening medicines. There is a great demand for this drug and its cultivation can be safely recommended.

Derris. The roots of *Derris elliptica and D. malaccensis* contain rotenone, used in large quantities in the manufacture of insecticides. The world's supplies come from Malaya and neighbouring islands. In the first instance it is not possible to obtain supplies from these localities at present. Even if it were available the foreign product is so costly that its purchase is simply prohibitive. We want cheaper supplies for India. The indigenous species of Derris are very low in rotenone content, hence attempts should be made to acclimatize some of the exotic species. There is good scope for their cultivation in India.

Besides such crops as Cinchona and Pyrethrum—the large scale cultivation of which has already been advocated in the past—there is a long list of plants including Digitalis, Peppermint, Belladona, Ergot, Calophyllum, Chenopodium, Vanilla, Camphor, Cascara, Rozelle, Celery, etc. which merit attention. The soybean has not been mentioned because there appears to be at any rate at present no market for it in India, and further, the nutrition experts do not consider that as a pulse food it is superior to the pulses indigenous to the country. There is also a need for the trial of new fodder plants such as the Giant Star Grass from East Africa. Some of the new varieties produced by crossing sugarcane and sorghum have possibilities as drought resistant fodder plants.

Bureau for new crops. It should be made clear that plants about which notes have been given above are by no means recommended to the public for immediate cultivation As has already been stated earlier, it is desirable that we should first collect and collate the available information on the less well known economic plants in India. The data so obtained would then have to be considered by a planning committee on which Directors of Agriculture, Economic Botanists, and the trade and the marketing organizations would be represented. Such a committee would then be in a position to offer authoritative recommendations as to what new economic crops should be grown and where. When the subject of new economic crops was recently discussed at the meeting of the Crops and Soils Wing of the Board of Agriculture in India it was suggested that the State should give a guarantee against loss to growers who are prepared to undertake trials with new plants.

It was also suggested that besides the action to be taken immediately it was desirable as a matter of long range policy to establish a Bureau for the introduction and testing of varieties of plants, similar to the organizations existing in the United States of America and several other agriculturally advanced countries. The function of the Bureau would be to collect material from all parts of India and from abroad for preliminary testing and despatch of such material, a merited further test to such regions of the country as appeared to be suitable for it. It would keep in touch with the industry and trade so that the commercial possibilities would be tested as early as possible. Arrangements would have to be made for suitable quarantine arrangements to see that no new pests or diseases are introduced into this country along with imported material.

If such a Bureau is set up, we should have the means of exploiting the plant material of the whole world for the varied climates and soils of this sub-continent and we should be in a position to give clear recommendations as to what additional crops could be grown with profit and where. (*Indian Farming* Vol. III No. 5 of 1942.)

Degeneration of Improved Crops in India.

By B. P. PAL,

Imperial Agricultural Research Institute, New Delhi

When an improved variety of an agricultural crop is released for general distribution among cultivators by the Agricultural Department, sooner or later a report generally follows that the improved variety has deteriorated or degenerated. Farmers, dealers and commercial seed growers complain that the acre-yield of the improved variety has gradually decreased or that the variety has deteriorated in quality, a few years after its introduction. As the cultivator's return ultimately depends upon the quantity and the quality of the crop he grows, it is of paramount importance to consider the various causes that may lead to the degeneration of an improved variety and to find out such measures as can be practised by the cultivator and the plant breeder to reduce it.

Causes of deterioration. It is well known that the behaviour of an improved variety or in fact of any variety is the function of the genetic constitution it inherits and the particular environment in which it grows. A change in either of these may result in deterioration. Thus the causes of deterioration may broadly be classified into genetic and non-genetic. The latter will be considered first.

When an improved variety is given out for distribution, it comes to be grown on areas, and under conditions which are different from those where the variety was bred. If its cultivation is extended to areas not particularly suited to its growing, then naturally it will not grow or yield so well as formerly. Unsuitable soil conditions and unfavourable climatic conditions such as rainfall and length of day may profoundly influence the general performance of a variety. An interesting case of deterioration in quality of wheat grain was reported from Bengal a few years ago when two samples of wheat of the same variety were supplied by a correspondent to the Agricultural Commissioner. One sample grown in the Punjab showed well-filled hard grains, while the other sample which had been grown in Bengal from the same original seed consisted of shrivelled grains, of rather uneven texture, and was considered to have deteriorated. When these two lots of seeds were sown at the Imperial Agricultural Research Institute at New Delhi it was found that they gave rise to plants which did not differ in any observable characters. The deterioration observed when this wheat was grown in Bengal was therefore the result of growing it under very different soil and climatic conditions from those obtaining in its original home. It is the general experience that wheats grown under *barani* (rain-fed) conditions usually yield harder and more lustrous grains than those grown under conditions of irrigation even when the same varieties are used. An apparently detrimental influence of environment on the quality and the quantity of an improved variety may thus give rise to the cry of deterioration.

In crops like cotton the question of quality is specially important and it is known that the fibre qualities of this plant may be altered as a result of changes in environment. A cotton strain which spins upto 40 counts when grown in Madras under irrigatated conditions hardly spins 30 counts when grown as a rain-fed crop in central India. Unsuitable soil conditions also lead to a decrease in acre-yield. An improved variety, due to its high-yielding capacity, may remove comparatively a greater amount of fertility from the soil than the original poor-yielding one. Its continuous cultivation, without proper rotation, may result in the exhaustion of the soil, and the subsequent yields, therefore

are much less than the previous records. This may be another of the reasons for the general complaint that recommended varieties deteriorate. Agricultural Departments with the aid of the plant breeder should as far as possible prescribe definite tracts for improved varieties. The evils of deterioration due to unsuitable environmental conditions will then decrease to a substantial degree. The cultivator should as far as it lies in his power take adequate measures to replenish the soil so that the acre-yield will not fall due to poor soil conditions.

Attack by diseases. Sometimes an improved variety is considered to have deteriorated because it is affected by diseases to which it was supposed to be resistant during its creation or in the early days of its expansion. The causes of such deterioration are obvious. Certain improved varieties are not affected by diseases in a particular locality. In some cases they are free from the disease, not because they are resistant to it, but because the causal organism responsible for the disease is absent. When such a variety is extended to an area where the causal organism is prevalent, the variety naturally falls a victim to it. The problem of the disease resistance is further complicated by the fact that the causal organism, for example the fungus causing the rust disease of wheat consists of different varieties which are recognized by plant pathologists as physiologic races. A particular wheat may not be affected by one physiologic race, but it may be highly susceptible to another. For instance, a popular variety of the wheat of the Bombay Presidency, Bansipalli 808, is resistant to two out of the six forms of black stem rust. It is attacked heavily in the southern parts of Bombay, but it generally escapes rust in the Deccan. The so-called deterioration will, therefore, in such cases depend upon the distribution and seasonal incidence of these physiologic races. A particular variety may appear to be resistant to a disease, simply because it escapes the diseases by ripening at a time when the environmental conditions are not suitable for the vigorous growth of the fungus. It is reported that IP4 wheat, being early escapes rust attack in Bombay. If on the other hand the variety ripens some time after the appearance of the fungus, heavy infection is the outcome. It is desirable that the plant breeder should test his varieties for resistance under optimum conditions of infection to disease before releasing them for general distribution. Thus in Bombay, Jarila and Jaywant, two improved varieties of cotton, where supposed to be resistant, but succumbed entirely under optiumum conditions of infection. The Sharbati wheats of the Central Provinces, A112, A113 and A115 evolved from a cross between a common wheat and *Khapli* wheat were thought to be resistant to stem rust, but later on were found to break down in their resistance. But the resistant parent *(Khapli)* concerned in the breeding of these wheats has been shown by later work to be not resistant to all the races of rust occurring in India. It must be pointed out, moreover, that at the time these were brought out, there was no accurate information regarding the physiologic races of the rust prevalent in the province.

Mixture with poorer types. Another potent cause of the deterioration of an improved variety is its mechanical admixture with poorer types. Proximity of threshing grounds, the use of the same yards, contaminated drills and seed-bins often cause extensive mixtures. In cotton, seeds may be mixed up in ginning factories. If the mixture of two or more varieties is perpetuated, a poorer type, due to its better adaptability to environment, may dominate the improved variety which will then be considered as having deteriorated. Since it is extremely difficult to prevent mechanical mixtures altogether, the best that can be done is to minimize the extent of contamination. The importance of thorough rogueing of the off types is too obvious to need any emphasis. Extensive propaganda should be carried on regarding the advantages of rogueing, so that farmers

may come to consider this operation as a normal routine in the cultivation of improved varieties of crops.

An improved variety may undergo degeneration if a change takes place in its genetic constitution. It is generally supposed that an improved variety released for distribution is pure, i. e. it breeds true to its type. When two varieties of a crop are crossed together with a view to evolving a better type, the progeny of the first few generations exhibit a wide range of variability in their characters. The plant breeder selects plants which possess the combinations of attributes he desires, in each generation till his selected plants appear to be breeding true. They are then said to be pure. But recent advances in the science of genetics reveal that such strains are pure only for the more obvious characters and there may still exist variability in respect of physiological and other characters. Naturally, therefore, the variety will still manifest a range of genetic variability, though on a limited scale. In a few years new types would arise, among which would be a few obviously different from the bulk. These rogues, if unnoticed, will multiply and the improved variety will appear to have deteriorated. In order to check this evil, the plant breeder should assure himself that genetic variability is reduced to a reasonably low level before he certifies a new variety for general release. Secondly, the Agricultural Department must have stations responsible for maintaining genuine and pure seeds of the improved varieties. At these stations suitable systems for maintaining purity must be adopted and secondary selection carried out as found necessary. The new strain of cotton, Jarila, in Bombay is an example of secondary selection from an improved strain Verum 262 from the Central Provinces.

Natural crossing. The phenomenon known as natural crossing is one of the most important sources of deterioration in improved varieties. Although many of our important crops like rice, wheat and cotton are self-fertilized, they are liable to cross-pollination also. If different varieties of the same crop are grown in the vicinity of one another, as generally is the case in the cultivator's fields, there is every chance of the better variety being crossed with an inferior one. The segregating progeny of such a cross will naturally contaminate the population of the improved variety. Rogueing of the off types can be suggested as the best control measure for reducing the extent of deterioration due to natural cross-pollination. In this connection, the problem of deterioration among naturally cross-fertilized crops may briefly be considered. Crops such as the oil-yielding *Brassicae*, maize, and *bajra* are normally cross fertilized. Some of them are almost totally self-sterile, while in others a reduction in vigour occurs if self pollination is compulsorily enforced. In such plants single plant selection is impossible, and pure seed is raised by selecting a limited number of plants as closely alike as can be found and growing them in isolation. In the case of these plants, the maintenance of uniform strains is a matter of difficulty and the possibilities for rapid deterioration of a cross-fertilized crop are very great.

Then there is the case of the vegetatively propagated crops such as potatoes and sugarcane. Degeneration has been traced in these crops to be the cumulative effects of virus diseases which are handed on with the tubers, setts, etc. in the process of vegetative propagation. The damage thus caused can be extremely severe and the importance of using disease free planting material cannot be over emphasized.

The hereditary constitution of a plant may be altered by sudden change known as 'mutations'. Sometimes these changes are so minute that they may escape detection, but an accumulation of such inferior mutations may lead to deterioration of an improved variety.

Essential precautions. From the foregoing account it will be clear that so called deterioration may result from a number of causes. Although the cultivator can preclude the possibilities of deterioration to a considerable extent by taking care to keep his seed pure and by maintaining the fertility of the soil, the plant breeder and the Agricultural Department can also help. The latter should recommend suitable varieties for definite tracts, so that deterioration due to unfavourable environmental conditions will be avoided. Extensive propaganda is needed to impress upon the mind of the cultivator the importance of rogueing off-types before harvesting the crop. The Department should also undertake seed supply schemes, as is being done in cotton by the Indian Central Cotton Committee, so that the cultivator may get pure seed at a reasonably cheap rate. In this connection it may be mentioned that most of the agriculturally advanced countries have got seed legislation in force preventing cultivators from growing anything but certified pure seed. As seed supply arrangements make progress such seed legislation may be required in this country also. The breeder must take all precautions to keep his strains absolutely pure so as to be able to supply pure seeds, true to variety, which can serve as 'foundation stocks' for multiplication. Systematic experiments must be laid out to find out how many generations from the breeding plot an improved variety can maintain its character in the cultivator's fields without undergoing any substantial deterioration, so that the cultivator may be advised to renew his stock of pure seed accordingly.

Finally, it can be concluded that degeneration or deterioration of improved varieties is not inevitable if suitable precautions are taken. If this is done then and only then, the cultivator will be able to derive the full benefit from the plant breeder's work. (*Indian Farming* Vol. III, No. 5, 1942).

Gleanings.

New Avenues for Utilising Bagasse. The Imperial Council of Agricultural Research gave a grant to the Forest Research Institute to investigate how an economic utilisation of bagasse can be made. The report of the investigation has been recently published. Bagasse is used in the United States for manufacturing insulation boards, sold under the names of 'Celotex' and 'Canec'. Following this lead, the investigators began work to evolve out of the patented processes a suitable and economical method of converting bagasse into insulation and pressed boards. Demands for heat insulation and acoustic corrections in big halls and public buildings are growing in the country, and in addition uses as ceiling and floor linings, plaster bases and partitions offer a further scope for consumption.

Boards have been produced with the desired properties and the investigators expect that difficulties to be encountered during a large scale manufacture will not be formidable. But it has been found that the whole process can be economical only on the minimum annual output of 1600 tons (600 of insulation boards and 1000 of pressed boards) requiring 2400 tons of air dry bagasse. A mill located near the sugar mill centre will have little difficulty in getting this supply of the raw material. The immediate work for commercially exploiting the results of these investigations is to stimulate an increase in the present demand. The present import statistics give a consumption figure at half the production of the smallest economic unit.

Experiments on the production of wrapping paper and straw boards were also included in the programme of the work. Successful utilisation of bagasse for both purposes has been made on a semi-commercial scale. But the smallest economic unit for each requires bagasse in such quantities as are not at present

available, and if made available the prices may not be competitive. It now rests with the entrepreneurs of our country to provide the atmosphere to make use of these profitable experiments. (*Science and Culture*, April 1942, Vol. 7, No. 10, P. 493).

New Developments in Cotton Utilisation. Due to the war, export markets for America's cotton crop has been largely cut off. The U. S. A. Department of Agriculture as a consequence sponsored a special research programme and has announced two new industrial uses for cotton. Smokeless gun powder has so long been manufactured by utilising the short fuzzy fibres left after the ginning process. These fibres were best for the nitrating process. The long staple cotton becomes entangled and obstructs the process. The long fibres have been now successfully utilised by the Bureau of Agricultural Chemistry and Engineering for manufacturing gun powder. Machines like giant lawn mowers now cut off the staple cotton, and each is capable of handling two tons of cotton per hour. This added production of explosive cellulose nitrate has been helpful in the defence programme. The short fuzzy fibres or the cotton linter may now be extensively put to use for the manufacture of rayon, cellulose acetate plastics and nitro-cellulose lacquers. The second development of interest to cotton growers is the possibility of growing an unusual variety of cotton for its wax rather than its cellulose. This variety known as Arkansas Green Lint yields 17 per cent. of wax instead of usual one half of one per cent. A chemical company is collaborating with the agricultural department to produce a hard wax suitable for polishing shoes, furniture, automobiles and floors. (*Science and Culture*, March 1942, Vol. 7, No. 9, P. 437.)

Vitamin C Content of Fresh, Canned and Dried Guavas. The common guava, *Psidium Guajava*, has not as yet received the recognition which it deserves as a potent source of ascorbic acid. Both in Hawaii and in India values as high as 300 mgm. per 100 gm. have been reported for the fresh fruit, although many lower values are to be found in the literature.

We have investigated the vitamin C content of guavas from various parts of the Transvaal and the Cape Province. Ascorbic acid has been estimated by titration with indophenol in aqueous or dioxane solution, after extraction of the material with a 2 per cent. solution of metaphosphoric acid. Canned guava juice has been assayed biologically by Key and Elphick's modification of the Hojer tooth method, the results being in agreement with those found by the chemical method.

Condition of the fruit.	Ascorbic acid content in mgm. per 100 gm.
Green and hard	25)—350
Ripe and firm	300—450
Over ripe and soft	50—100

In the above table is summarized the variation of vitamin C content of the fruit as a whole with its condition. It will be seen that the amount of ascorbic acid present in the fruit increases as it ripens but soon diminishes as the guava becomes soft. Firm fruit of high vitamin content may be stored at room temperature for several weeks without serious loss of vitamin but where the guava is ripe or infected with fruit fly the value decreases rapidly.

There does not appear to exist a wide variation in the vitamin content of fruit of different varieties or from various districts. On the whole however, white-fleshed guavas are usually slightly richer in ascorbic acid than those with pink flesh.

Of the different parts of the fruit, the skin has the highest content, the inner pulp contains little, and the stones none at all. The proportion of ascorbic acid found in skin, outer pulp and inner pulp may be as high as 12 : 5 : 1.

When selected firm fruit is canned the ascorbic acid present in fruit and juice reaches levels of 200—300 mgm per 100 gm. The use of soft fruit is attended by a sharp decrease in the vitamin content, values as low as 18 mgm. per 100 gm. being found in some cases. These low values also obtain under conditions favourable to the oxidation of the vitamin such as pulping or overcooking.

The most successful procedure for the preservation of the vitamin has been found by us to be drying at low temperature. The unpeeled fruit is quartered, the central pulp and stones removed and the residue blanched for two minutes. Thereafter the fruit is dried at 130° F. for 10—12 hours and powdered. Powdered guava prepared in this manner contains 2,500—3,000 mgm. per 100 gm. (white) and 2,000—2500 mgm. per 100 gm. (pink). Failure to blanch the fruit prior to drying results in lower values (1,000—1,500 mgm per 100 gm.). Thus dried guavas compare favourably with other rich sources of the antiscorbutic vitamin such as dried rose hips, reported by Lund, Spur and Fridericia to contain 2,000 mgm. ascorbic acid per 100 gm. Moreover, the guava powder has a pleasant aromatic odour and practically no taste.

The above results, taken in conjunction with the wide distribution of the various species of guava and the ease with which they can be grown, justify their extensive cultivation and consumption. Full experimental details will be published later. (*Nature* Vol. 148 : 286; September 6, 1941.)

Press Notes.

Food Production Campaign in the Tanjore District. It is common knowledge that due to the situation created by the war and the stoppage of imports of rice from Burma there is great need to increase food production to meet the requirements of our province. Every district is expected to do its utmost to avoid the shortage of food grains by increasing its output of cereal crops but Tanjore with its highest area under the most dependable crop, viz., paddy, has the special responsibility of increasing its yield of rice by every possible means. Here are some of the ways by which Tanjore can contribute its share.

Government have recently passed orders offering water for irrigation in the Tanjore district this year a month earlier than usual and water is expected to be available from the 25th May. This concession is intended to encourage the cultivators to convert not less than one lakh of acres of single crop paddy lands into double crop paddy lands and raise the nurseries of *Kuruvai* paddy as soon as water is let in in the channels. If the seedlings are transplanted in July the crop comes to harvest before the outbreak of the North-East monsoon in September. The crop is safe even in coastal areas if it is transplanted in July. The conversion of one lakh of acres of single crop lands into double crop land will give an additional yield of 10 lakhs of bags of paddy.

There are still about one lakh of acres included as dry land in the wet ayacut of the Cauvery—Mettur project. With water available so early this year, it will be easy for the *ryots* to convert these lands into wet fields for raising a samba crop. This would give another 5 lakhs of bags more. Further, in Pattukottai and Arantangi taluks *ryots* are in the habit of starting cultivation late in September or October using water from tanks fed by the Cauvery—Mettur project. With the water facilities available this year they can raise one short duration *Kuruvai* crop in June followed by a second crop of *Samba* or alternatively they can raise a *Samba* crop in July and take a second crop afterwards in January with water available from tanks.

As water is available early this year, it is possible to raise a green manure crop like dhaincha, sannhemp or *pillipesara* during the interval of three months between letting in water and transplanting of *Samba* crop. The yield of these green manure crops ranges from 15,000 to 20,000 lb. The quantity required for

application as manure is only 4,000 lb. per acre: it will, therefore, be enough if a fifth of the land is put under green manure. This dose of green manure if supplemented with bonemeal at ½ cwt. per acre will increase the yield of paddy by 3 to 6 bags per acre. *Mirasdars* are advised to consult the local agricultural demonstrators for supply of green manure seeds. If it is not possible to raise a green manure crop for any reason, it is enough if the land is manured at the rate of 2 bags of groundnut cake and ½ cwt. of bonemeal per acre before planting. This will also increase the yield.

Finally, the *ryot* should economise seed rate. Experiments have decidedly shown that the seedlings raised in 10 cents of land at the rate of one Madras Measure of seed per cent are quite enough to transplant an acre of land in the case of long duration varieties. For varieties with less than 4½ months duration the seed rate can be incresed to 1½ M. M. per cent in the same area of 10 cents. If this procedure is adopted throughout the district, it is estimated that not less than 10 lakhs of bags of paddy seed can be saved. It is unnecessary to sow 36 Madras Measures of seed per acre by following the local practice. If nurseries are raised at the rate of 1 or 1½ Madras Measures per cent it is enough if 2 or 3 seedlings are planted per hole 4 to 6 inches apart. A greater distance than 6 inches should be avoided. This practice has resulted in the increase of yield ranging from 1 to 1½ bags per acre.

If the methods suggested above are adopted freely by the Tanjore ryots whenever possible it will go a long way to meet the shortage of food grains in some of the districts. This is the contribution which the Tanjore district can easily make. By this contribution it is benefitting others while being benefitted itself. *(From the Director of Agriculture, Madras.)*

Thevetia nerifolia Juss—a potent new insecticide. Efforts by the Entomologist to find out suitable substitutes for the insecticides that are now difficult to obtain have resulted in the discovery of a contact insecticide of a high order in *Thevetia nerifolia*.

This plant originally a native of South America and West Indies must have been introduced into India many years ago. It flourishes well in South India and is commonly raised as a hedge plant. It is known as "Pacha ganneru" in Telugu and "Ponnu arali" in Tamil. The kernel inside the seed possesses toxins of great value.

It has been discovered for the first time that the kernel of this seed possesses insecticidal properties and can be used with benefit against harmful insects. Aqueous extracts of kernels prepared by soaking mashed or ground kernel in water for 24 hours are found to be highly toxic and give a high percentage of kill when sprayed on insects. Addition of soap is necessary to secure high toxicity.

The extract can be used at different strengths. A concentration of ¼ ounce of kernel in one gallon of water is very efficacious against soft bodied insects like plant lice, thrips and leaf hoppers. Defoliating caterpillars like the moringa hairy caterpillar, mango nettle grub and castor semi-looper, however, require a higher concentration of ½ ounce in one gallon of water. Mealy bugs and scale insects are found to require a still higher concentration—one ounce in one gallon of water. Occasionally a second spray may be necessary for the latter.

No injury is done to foliage when Thevetia extract is sprayed on plants at a concentration of one ounce and below per gallon of water. The extract appears to possess deterrent properties as plants sprayed with it secure temporary immunity for short periods from attack by pests.

Its value as a stomach poison has not been fully investigated and it is therefore, desirable to avoid spraying the extract on edibles a month before they are fit to be consumed. *(From the Director of Agriculture, Madras.)*

Sir T. S. Venkataraman, Ph.D., C. I. E., I. A. S. *(Retd.)*

Crop and Trade Reports.

Cotton Raw, in the Madras Presidency. The receipts of loose cotton at presses and spinning mills in the Madras Presidency from 1st February 1942 to 12th June 1942 amounted to 2,56,391 bales of 400 lb. lint as against an estimate of 5,63,800 bales of the total crop of 1941-42. The receipts in the corresponding period of the previous year were 3,12,468 bales. 2 89,885 bales mainly of pressed cotton were received at spinning mills and 1362 bales were exported by sea while 70,752 bales were imported by sea mainly from Karachi and Bombay.

(Director of Agriculture, Madras.)

Mofussil News and Notes.

Shiyali. A fairly big Agricultural Exhibition was conducted during the local *Sambandhar* Festival from 20—4—'42 to 30—4—'42 at Shiyali in a specially erected shed kindly donated by the Dharmapuram Mutt. The exhibition was very comprehensive and instructive. The Health and the Veterinary Departments also co-operated and took part in the Exhibition. About 5000 people visited the stall and the exhibition proved a great success.—(M. A.)

College and Estate News.

The 3rd and 2nd year B. Sc. (Ag.) classes resumed their work on the 15th of June with the re-opening of the College.

The Cecil Wood Memorial Fund. A meeting of the old students of Mr. R. Cecil Wood, Ex-Principal of the Coimbatore Agricultural College was held in the Freeman Building on 12th July 1928. A small committee was then formed with the object of collecting funds for perpetuating the memory of Mr. Wood. A sum of Rs. 236 was donated by students of Mr. Wood as well as his colleagues and an interest of Rs. 75—12—3 accrued, of which, a sum of Rs. 79—7—0 was spent towards an oil painting of Mr Wood and miscellaneous expenditure, leaving a balance of Rs. 232—5—3. With the concurrence of the resident subscribers, this sum is now to be invested with the treasurer of Charitable Endowments, Madras, under the trusteeship of the Principal, Agricultural College, Coimbatore, for award of prizes to the winners and runners-up in the annual Cecil Wood Tennis Tournament with the accruing interest. *V. T. Subbaiah Mudaliar.*

RETIREMENT

Sir T. S. Venkataraman, Ph. D., C. I. E., I. A. S.

Rao Bahadur Sir Tiruvadi Venkataraman was born in June 1884 in Salem District. He graduated out of the Presidency College, Madras, in 1905 securing the first rank amongst the Botany graduates of that year. He worked in his *Alma Mater* as a stipendiary research scholar from 1905 to 1907 and joined the Madras Agricultural Department in March 1907, as an Assistant to Dr. C. A. Barber. He taught Botany to the students of the Agricultural College, Coimbatore, from 1908 to 1910 and earned a name of being one of the most impressive teachers. Along with teaching, he started inheritance studies on Mirabilis, Clitoria, Euphorbia and also breeding work on cotton, *gogu* and redgram. His keen observational powers and earnestness in work caused him to be selected as the Senior Assistant in the

Cane Breeding Section newly opened in 1912 by the Imperial Department of Agriculture then at Pusa, with the object of improving the sugarcane crop in India. He was promoted to the Provincial Agricultural Service in 1918 and was placed in charge of the Cane Breeding Section after the retirement of Dr. C. A. Barber and to the Indian Agricultural Service with effect from 1919. He was due to retire in 1939 but was given an extension of service for three years.

It may be stated that at the time when Sugarcane Breeding Section was established on a temporary basis, the Indian sugarcane crop was threatened with extinction from import of large quantities of cheap sugar from Java and elsewhere. It was often expressed that the Indian canes could not compete with the highly productive bio-types evolved in Java. Even as late as 1919, Dr. Barber who was the first Sugarcane Expert at Coimbatore and who worked on canes in West Indies prior to his coming to India and who studied the peculiarities of Indian cane from 1912 to 1919 wrote to the London 'Times' immediately after his retirement, in a pessimistic tone about the future of the Indian cane industry. In fact, there was a time when one of the Retrenchment Committees, Inchcape Committee, almost suggested the closing down of the Imperial Cane Breeding Station and it is said one private company which owned a number of sugar factories in North India was prepared to finance the station if it was allowed to multiply the new canes in the first instance.

Sir Venkataraman was active during the early periods of the Cane Breeding Station, in the Botanical description and classification of Indian canes and in effecting crosses between the thin canes of North India and the thick South Indian varieties. The breeding work raised a number of complex problems like non-flowering habit of certain desirable varieties, non-crossability, low setting and non-germination of seeds. The question of hybridisation with wild types of sugarcane was thought of and Sir Venkataraman had no small hand in planning new methods and devising cheap tools in carrying it out to success. It may be stated that it was at the Cane Breeding Station, Coimbatore, that the wild cane *(Saccharum spontaneum)* was deliberately employed as parent for the first time in the world, to bring about improvements in the cultivated canes.

When Sir Venkataraman took charge of Cane Breeding at Coimbatore he practised hybridisation on a large scale with a number of plants which would not generally be thought of by ordinary crop breeders Inter-specific and inter-generic hybridisation was freely used. Sorghum was successfully crossed with cane in 1930 and with bamboo in 1937. All these activities brought out unthought of results. Strains suitable to sub-tropical conditions, resistant to drought, water-logging, frosty and saline conditions were isolated in quick succession. As a consequence, the improved strains began to replace rapidly old varieties and new areas were brought under canes. Big plantations were started and a number of sugar factories was constructed. Eventually, India, which was once a maior importing country

for sugar and the canes of which were said to be too poor for improvement has now been turned into one with a surplus. This progress would not have been possible but for the labours of Sir Venkataraman and his associates in cane breeding.

His canes have begun to spread outside India also. They are now under cultivation in Siam, China, Australia, the United States of America, Cuba, Porto Rico, British Guiana, Peru, Brazil, Argentine, Portuguese East Africa, Natal, Uganda. Egypt and Spain in fact in all the five continents.

Apart from these, Sir Venkataraman's activities were seen in other directions. He was often requisitioned on account of his unique method of creating interest in his speeches to give important lectures. He was requisitioned for the Subramaniam lecture in Madras in 1930, Travancore Lord Curzon Prize lecture in 1936, Maharaja Sir Sayaji Rao Golden Jubilee Memorial lecture at Baroda in 1936. Honours came thick on him. He was deputed by the Government to attend the International Sugarcane Technologist Congress held in Java in 1929 and in Australia in 1935 and to represent India in the International Genetic Congress in Great Britain in 1939. He was elected twice (1928 and 1938) as the President of the Agricultural section of the Indian Science Congress and its General President in 1937. He is one of the foundation fellows of the National Institute of Science, Calcutta. In 1941 he was awarded the Honorary degree of Doctor of Science by the Andhra University. His valuable contributions to cane improvement were recognised by several foreign countries. He was made an honorary member of the Cane Growers' Association in Mauritius and South Africa. He was elected Vice-President and sectional President of the International Society of Sugarcane Technologists.

Government also were not slow in recognising the merit of his work. The title of 'Rao Sahib' was conferred on him in 1920. He was then made a 'Rao Bahadur' in 1928. He was one of the recipients, of 'Jubilee Medal'. In 1937 he was declared as Companion of the Indian Empire. In recognition of his extraordinary merits His Majesty the King Emperor was graciously pleased to confer on him the Knighthood in January 1942.

Sir Venkataraman has published a number of papers on the principles and methods to be employed in the improvement of crops in general and of canes in particular.

He retires from service after an extension of three years on 30th June 1942. We wish him a long, happy and peaceful life in his retirement.

Departmental Notifications.

Gazetted Service

Transfers.

Sri A. Ramaswami Ayyar, D. A. O. on leave, D. A. O. Tinnevelly.

Subordinate Service.

Appointment.

Sri R. H. Krishnan, Assistant in Chemistry is appointed to one of the posts of Assistants for the Rice Research Station, Chingleput.

Transfers.

Name of officers.	From	To
Sri M. Damodara Prabhu,	F. M. A. R. S. Kasaragode,	A. R. S. Pilicode
„ U. Ananda,	F. M. A. R. S. Pilicode,	A. R. S. Kasaragode
„ K. Hanumantha Rao,	A. D. Hospet,	F. M. A. R. S. Siruguppa
Muhammed Ali Hyder Sahib,	F. M. A. R. S. Siruguppa,	A. D. Harpanahalli
Sri K. K. Raghavan,	Offg. D. A. O. Tinnevelly,	F. M. A. R. S. Koilpatti
„ N. Srinivasa Rao,	A. D. Kollegal,	A. D. Gobichettipalayam
„ A. K. Ramasubba Ayyar,	A. D. Gobichettipalayam,	A. D. Kollegal
„ S. Anantham Pillai,	F. M. A. R. S. Palur,	A. D. Villupuram
„ K. Narayanan Nair,	A. D. Namakkal,	A. D. Arkonam
„ V. Viswanatha Ayyar,	A. D. Arkonam,	A. D. Namakkal
„ T. Arunachalam,	A. D. Tiruchendur,	A. D. Srivaikuntam
„ J. S. C. Antony,	A. D. Srivaikuntam,	A. D, Dindigul
„ P. A. Kunhiraman Nambiar,	A. D. Dindigul,	A. D. Tiruchendur
„ D. Bapayya,	Tobacco Market Committee, Guntur,	A. D. Bapatla
„ G. Venkataramana,	A. D. Bapatla,	A. D. Nanguneri
„ K. S. Ramana Rai,	A. D. Harpanahalli,	A. D. Hospet
„ D. C. Hanumantha Rao,	Marketing Asst. Bezwada,	A. D Kovur.

Leave.

Name of officers.	Period of leave.
Sri G. Venkatakrishna Ayyar, F. M. Kallar and Burliar Fruit Station,	Extension of l. a. p. on m. c. for 1 month from 8—6—42.
„ N. Narayana Ayyar, A. D. Tiruchengode,	L. a. p. on m. c. for 3 months from 4—6—42.
„ K. M. Venkatachalam Pillai, Groundnut Market Committee, Cuddalore,	Extension of l. a. p. for 6 weeks on m. c. from 2—5—42.
„ C. Krishnamurthi, Agric. Asst. I. C. A. R. Sugarcane pest scheme, Nellikuppam,	L. a. p. for 30 days from 12—6—42.
„ K Narayanan Nair, A. D. Namakkal,	L. a. p. on m. c. for 3 months from 10—6—42.
„ K. Balaji Rao, A. D. Adoni,	L a. p. on m. c. for 1 month from 7—6—42.
„ M. V. Kondala Rao, A. D. Sompeta,	L. a. p. for 1 month from 9—6—42.
„ R. Krishnamoorthy, A. D. Chengam,	Extension of l. a. p. on m. c. for 2 months from 3—6—42.
„ V. G. Venkataramana Rao, A. D. Wallajah,	Extension of l. a. p. on m c. for 30 days from 22—6—42.